Multi-instrument comparison of integrated water vapour on high spatio-temporal resolution during the field campaign HOPE

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The exact knowledge of atmospheric water vapour is as equally relevant for everyday weather forecast as it is for climate monitoring and prediction. Not only is water vapour the most potent atmospheric green house gas, it also plays a keyrole in many meteorological processes such as cloud and precipitation formation. Various techniques exist by which water vapour can be measured. However, these often lack an appropriate error estimate.

During the High Definition Clouds and Precipitation for advancing Climate Prediction (HD(CP)²) Observational Prototype Experiment (HOPE) which took place at the mid-latitude site JOYCE, Germany, during April-May 2013, a large variety of instruments capable of detecting water vapour was operated. During the campaign, the standard instrumentation at JOYCE, that is the GPS antenna of the Geoforschungszentrum Potsdam, a scanning microwave radiometer, and a sunphotometer, was complemented by frequent radiosoundings, four additional microwave radiometers, and the BASILicate Raman Lidar system (BASIL). Additionally, integrated water vapour (IWV) from two Moderate Resolution Imaging Spectroradiometer (MODIS) retrievals, infrared and near infrared, are available from Terra and Aqua overflights. The retrieved IWV products from this suite of instruments vary in temporal and spatial resolution, accuracy, continuity, and atmospheric conditions under which they are applicable.

The present study performs a multi-instrument comparison of IWV, with the primary goal of quantifying the errors in retrieved IWV. A realistic error estimate is essential for the compilation of climatological time series, which require long-term stability and consistency. Focus is on the high small-scale spatio-temporal variability of IWV, which influences the assessment of accuracy of larger scale atmospheric model simulations and space-borne observations like the Infrared Atmospheric Sounding Interferometer (IASI).